

# ALTIMETER DATA FOR OPERATIONAL USE IN THE MARINE ENVIRONMENT

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**ABSTRACT** - Altimeter data from TOPEX/POSEIDON have been used to produce maps of sea surface height, geostrophic velocity, significant wave height, and wind speed. Uses of the data, often in conjunction with other data sources, include commercial and recreational vessel routing, ocean acoustics, input to geographic information systems developed for the fishing industry, identification of marine mammal habitats, fisheries management, monitoring ocean debris, weather and climate forecasting, and hurricane forecasting. As with sea surface temperature data from the Advanced Very High Resolution Radiometer (AVHRR) in the late 1980s and early 1990s, altimeter data from TOPEX/POSEIDON and ERS-1 and -2 are in the process of being introduced to the marine world for operational maritime use. It is anticipated that over the next few years more companies that specialize in producing custom products will be incorporating altimeter data. This paper will discuss the following subset of applications: commercial and recreational vessel routing, underwater object detection, fishing industry, and identification of marine mammal habitats.

## I - INTRODUCTION

Altimeter data products are in the process of making the transition from scientific to operational use. Altimeter data from TOPEX/POSEIDON, which is an Earth orbiting satellite, have been used extensively by the science community to better understand ocean circulation and the role of the oceans in climate and weather. As derived products have been made available, use of the data for operational purposes has increased, as it has become evident that the data complements other ocean information.

## 2 - APPLICATIONS

### 2.1 Ship routing

Maps of sea surface anomalies overlaid with velocity vectors have been used in commercial shipping and competitive sailing to optimize the route from one destination to another. The maps are used to locate ocean features such as currents and eddies which are associated with high currents. In cases where the rhumb line, the shortest distance between two points goes through strong currents a variety of tactics can be used. In the case where the rhumb line crosses orthogonal to a current, sailors are likely to cross at a point and at an angle such that the duration of the crossing is minimized.

### 2.2 - Underwater object detection

Navy operations are critically dependent upon the ocean environment. Ocean acoustics determine the ability of ships to detect objects within the water, and the detection of objects such as submarines is vital to the safety of the fleet. Ocean acoustics in turn are determined by temperature and salinity properties within the ocean. Within the deep ocean, the dynamics affecting temperature and salinity may be measured through altimetry. Positive sea height anomalies (bulges) are usually associated with warm water and a depressed thermocline. Alternatively, sea level depressions are associated with cold

water at a raised thermocline. The Navy Modular Ocean Data Assimilation System (MODAS) uses historical in-situ data to derive statistical relations between surface observations (dynamic height and temperature) and subsurface quantities (temperature and salinity)

### **2.3 – Offshore industries and precision operations**

Accurate estimates of the current and future state of the ocean are very useful to industries involved in offshore activities. Offshore operators that have used altimeter-derived monitoring tools include companies working on cable laying and hydrocarbon exploration and production. Cable laying and repair requires accurate knowledge of the ocean circulation to minimize the impact of strong currents on the activities of the cable ship as it tends the cable and on underwater remotely operated vehicles working on the cable. Altimeter data have been used to identify regions of strong currents along the edges of oceanic eddies, a monitoring capability that is especially important when thermal imagery is not available because of cloud cover. The offshore hydrocarbon industry has also made extensive use of near real-time altimeter products and an operational nowcast/forecast system relying on altimeter data assimilation (Kantha et al., 1999). Near real-time nowcasts and forecasts are available from the University of Colorado for potential use by the offshore oil and gas industry.

### **2.4 – Fishing industry**

Marine life is very often concentrated along oceanic frontal regions, which can be detected from altimeter-derived data. In cooperation with NASA, satellite altimetry is being provided to SciFish to incorporate into their Geographical Information System (GIS), FishTrek98. The product runs on a laptop PC integrated with a Global Positioning System (GPS) receiver for real-time analysis and positioning. FishTrek98 is designed to provide ship captains with a variety of essential information such as bathymetry, snags, water temperature, historic catch figures, and by catch. In addition, vessel captains can log their catch, tide, current, marks, snags, temperature, sea conditions, weather, and lunar conditions in a personal electronic log book that is integrated with other available data sources.

### **2.5 - Marine mammal habitat monitoring**

Altimeter data were used to locate eddies as part of the 1996-1997 GulfCet program. GulfCet was a field program run by Texas A&M oceanographers based in College Station, marine mammal biologists based in Galveston, with support from satellite oceanographers at the University of Colorado. The program made a survey of the Gulf of Mexico's 18 common cetaceans in continental margin areas of present oil and gas development. Altimetric monitoring of the general circulation in the Gulf of Mexico served two purposes in GulfCet studies. Near-real-time altimeter data were used to map eddies, information which was used to plan research cruises to optimize the census process. Following the cruise historical altimeter data were used to map the fronts and eddies that occurred during the cruises. These historical data helped marine mammal biologists interpret when and where cetaceans were found during the cruises.

## **3 - FUTURE DATA PRODUCTS AND DATA STREAMS**

There are a number of sources of data and products. Links to these are provided through <http://topex-www.jpl.nasa.gov>. To be truly operational, the stream of data must be assured. This is being accomplished with the planned launch of Jason-1 in May 2000. It is anticipated that with growing familiarity of the benefits of altimeter data, that the data will be used as a complement to other remotely sensed and in-situ data.

### **REFERENCES:**

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